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ORIGINAL ARTICLE

Comparative Study between Laparoscopic-Assisted Percutaneous Internal Ring Ligation for Inguinal Hernia Repair and Traditional Laparoscopic Herniotomy in Pediatrics

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ABSTRACT

Background: One of the surgical procedures most commonly done on newborns and young children is the repair of an inguinal hernia. This condition can be treated with a laparoscopic procedure or a traditional open treatment. This study aimed to evaluate the outcome of laparoscopic repair of pediatric inguinal hernia.

Methods: This prospective study was carried out on 24 patients with inguinal hernia who underwent laparoscopic hernia repair at the Pediatric Surgery department, Zagazig University Hospital. Patients were divided into groups A, who performed traditional laparoscopic inguinal herniotomy, and group B, who underwent laparoscopic-assisted percutaneous internal ring ligation. Intra- and postoperative complications, postoperative stay, cosmesis, and the size and vascularity of the testis were recorded and compared for differences in the outcome.

Results: The duration of operation was significantly shorter in the Group A procedure compared to the Group B procedure. The duration of unilateral hernia operation is significantly shorter compared to bilateral hernia in both procedures. There was a significantly lower VAS pain score in group A compared to group B. The duration of hospital stay was shorter in group A than in group B. There was no difference regarding the occurrence of complications in both procedures, $p > 0.05$. There was a significant difference in cosmetic outcomes in Group A compared to Group B, which was in favor of Group A.

Conclusion: Compared to conventional laparoscopic inguinal herniotomy, laparoscopic-aided percutaneous internal ring ligation is thought to be a new, minimally invasive, safe, simple, and quick procedure.

Keywords: Inguinal Hernia Repair; Traditional Laparoscopic Herniotomy; Pediatrics

INTRODUCTION

Before laparoscopic surgery became common, the gold standard for treating inguinal hernias was open repair with high ligation [1].

Although laparoscopic herniotomy (LH) was first offered 22 years ago, there is still disagreement on the best method for repairing inguinal hernias. The first description included a purse-string periorificial suture at the internal inguinal ring (IIR) and an intraperitoneal (IP) approach with a partial sac section. After that, extraperitoneal (EP) techniques were developed with good results to circumvent the requirement for intracorporeal knot tying [2].

As opposed to the traditional open approach, laparoscopic procedures are less invasive and, therefore, associated with less pain and a quicker return to normal functional status. They also provide excellent visual exposure, minimal dissection, and an improved cosmetic result. This is why laparoscopic procedures are becoming more and more popular. With the majority of parents requesting the operation, laparoscopic inguinal hernia repair in children has gained popularity as an alternative to the traditional open procedure [3]. Percutaneous inguinal ring suturing (PIRS) is a straightforward, single-port technique for laparoscopic repair of pediatric inguinal

hernias that allows the surgeon to achieve percutaneous closure of the internal inguinal ring using non-absorbable suture [4].

In this study, we compared the traditional laparoscopic inguinal herniotomy and the laparoscopic-assisted percutaneous internal ring ligation for the repair of inguinal hernia in pediatrics.

METHODS

This prospective study was conducted on 24 presented with inguinal hernia who underwent laparoscopic hernia repair in the Pediatric Surgery department in Zagazig University Hospital over 6 months from August 2023 to February 2024, intra- and postoperative complications, postoperative stay, cosmesis, the size and vascularity of testis were recorded and compared for differences in the outcome. The hospital ethical committee approved the study protocol, and parents signed a detailed informed consent.

All children presented with inguinal hernia were included in the study except for very low birth weight, major cardiac anomalies, ascites, and failure to obtain consent.

All cases were divided into two groups:

- Group A: patients with inguinal hernia underwent traditional laparoscopic inguinal herniotomy.
- Group B: patients with inguinal hernia underwent laparoscopic-assisted percutaneous internal ring ligation.

Inclusion criteria:

Children with inguinal hernia patients in the age group below 12 years old.

Exclusion criteria:

Children with strangulated or incarcerated inguinal hernia and Age > 12 years old. Contraindications to laparoscopic and thoracoscopic procedures have been reported and are considered relative or definitive and anatomic or physiologic. The most common relative contraindications to be considered are re-operative abdomens caused by adhesion formation, coagulopathy, cirrhosis, aberrant anatomy, small bowel obstruction, disseminated abdominal cancer, pulmonary compliance and cardiovascular issues, and intracranial disease.

Ethical Consideration:

The study was approved by the Zagazig University Academic and Ethical Committee (IRB#10538-7-3-2023). Written informed consent was obtained from all the participants. This work has been carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Preoperative evaluation:

To confirm the diagnosis of inguinal hernia, determine its kind, and check for consequences, a thorough history taking and clinical examination is performed, encompassing the inguinal region and the scrotum. Assessing the laterality of the hernia and the extent of the hernial defect can be done using bilateral inguinoscrotal probe ultrasound, scrotal Doppler ultrasonography for both testes, and abdominal-pelvic ultrasonography. Meticulous two-month postoperative follow-up to compare the two groups. Prior to surgery, all patients were instructed to fast for six hours.

Following a sensitivity test, a prophylactic single dosage of third-generation cephalosporin was administered 0.5–1 hour prior to the procedure or during the induction of anesthesia.

Operative procedure:

1. Preparation: for laparoscopic herniotomy

After receiving general anesthesia, the patient was put on the operating table in the supine position, and the entire abdominal wall—from the nipple line to the mid-thighs was thoroughly scrubbed. A urinary catheter was placed. The insertion of a nasogastric tube of the appropriate size is used to contract the stomach if it is enlarged. After the trocar is introduced, the patient is positioned in the Trendelenburg position with the table tilted towards the surgeon. The monitor is positioned at the foot of the hernia side, the surgeon is positioned towards the opposing side of the shoulder, and the helper is positioned across from the surgeon.

Step 1: Placement of trocars:

The open technique for optics of 5 mm and 0°/30° is used to install a 5mm 30 telescope trans-umbilical port; in group A, only two trocars are positioned at the right and left mid-clavicular lines at the level of the umbilicus. The functioning ports were positioned slightly above the umbilicus in newborns and babies. Children between the ages of 2 and 6 should receive insufflation with 10 mm Hg CO₂, whereas patients older than 6 should receive 12 mm Hg CO₂ insufflation at a rate of 1 L/min.

Step 2: Identification of anatomic landmarks:

An exploratory laparoscopy is initially performed to identify the inguinal area and significant anatomical markers such as the umbilical ligament, epigastric arteries, triangle of doom, and triangle of pain.

Step 3: Procedure technique:

To separate the sac from the peritoneum in group (A), an incision was made at the internal ring. After the vas and veins were removed under direct view, the anterior dissection was performed

after dividing the peritoneum posterior to the internal ring. Vas and vessels were avoided at all costs. After the sac from the peritoneum was dissected, the hernial sac was excised. Next, a round body needle with absorbable 3-0 polyglycolic acid is used to seal the peritoneal defect. After trans-abdominally inserting the needle, the deep ring is sutured with a purse string. The dissector is used to help feed the peritoneal bits onto the needle while the peritoneal defect is being closed. The needle is kept comparatively stationary during this process. Once suturing is completed, the trocars and needles are taken out. After the abdomen had contracted, the supra-umbilical incision was sealed with a polyglycolic acid suture. Sutures were used at three mm trocar sites.

The internal ring site in group (B) was identified externally by finger indentation and recognized internally. Here, a 20-gauge intravenous cannula was introduced, filled with proline 3/0 suture folded at the tip. It covered one-half of the internal inguinal ring (IIR) and formed the loop at its inferior edge. After removing the cannula and discarding the loop, it was reinserted via the original puncture site. Afterward, a second proline 3/0 suture was inserted through it. It addressed the second half of IIR. This suture's tip was inserted into the first loop that was made. The IIR was fully encircled by the second suture and the preceding loop suture, which were drawn outward. To occlude the defect, a tight knot was placed subcutaneously. The skin was sutured after the 5 mm port site defect was countered with port Vicryl (**Fig. 1**).

Postoperative management and follow-up:

- Patients were discharged the same day or the following day and were urged to resume unlimited activity as soon as possible following the procedure.
- Postoperative analgesics were administered for the first two days, after which they were stopped.

Postoperative Parameters:

Early ambulation; early postoperative sequelae, including hematoma, urine retention, wound infection, and scrotal edema.

Follow-up parameters: A standardized telephone script was used to follow up with all patients at the pediatric surgery outpatient clinic after one week, then every two weeks for six months. All patients were, however, advised to consult with us if they observed anything out of the ordinary.

The following topics are presented at follow-up visits:

- Late-onset problems following surgery, such as

persistent discomfort (consisting of inguinal or scrotal pain or pain in the mid-thigh region after surgery).

Testicular atrophy, hydrocele, and iatrogenic testicular ascent are examples of recurrence, along with the type of recurrence (defined as a palpable hernia or a visible defect in the abdominal wall, which in the event of doubt is validated by Superficial probing ultrasonography).

STATISTICAL ANALYSIS

Data was analyzed using Microsoft Excel software and then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data, qualitative represents numbers and percentages, and quantitative continues group represents mean \pm SD. Differences between quantitative independent multiple by ANOVA. P value was set at <0.05 for significant results & <0.001 for high significant results.

RESULTS

The current study showed the gender of studied children distributed as 66.7% males and 33.3% females, their age range from 3 year to twelve years with a mean age of 5.0 ± 3.13 , children's body weight range from 11 to 34 (kg) with a mean weight of 20.33 ± 6.4 in the group (A). In group B, the gender of studied children was distributed as 58.3% males and 41.7% females, and their ages ranged from 3 years to eleven years, with a mean age of 5.67 ± 2.19 . Children's weight ranges from 10 to 37 (kg) with a mean weight of 22.17 ± 6.6 , maturity of studied children. There were no significant differences between groups regarding gender, age per year, and body weight, $p>0.05$ (Table 1).

There were no significant differences between groups regarding hernia laterality, side, types of hernia, and ultrasound defect size on both sides ($p>0.05$) (Table 2).

The duration of operation was significantly shorter in the Group A procedure than in the Group B procedure, $p=0.0001$. The duration of unilateral hernia operation is significantly shorter compared to bilateral hernia in both procedures. The post-operative Pain VAS score ranged from 0 to 2, with a mean score 1 ± 0.67 in group A, compared to 4 to 6, with a mean score of 4.75 ± 0.75 in group B. There was a significantly lower VAS pain score in group A compared to group B, $p=0.0001$ (**Table 3**).

The duration of hospital stay was shorter in group A than in group B, $p=0.0001$ (**Table 4**).

There was no difference regarding the occurrence of complications in both procedures, $p > 0.05$ (Table 5).

There was a significant difference in cosmetic outcome between group A and group B, $p = 0.013$, in favor of group A (Table 6).

Table 1: Patients' characters of studied groups

Variables	Group A N=12	Group B N=12	Test of sig	p
Gender n (%)				
males	8 (66.7)	7 (58.3)		
Females	4 (33.3)	5 (41.7)	f	0.99
weight (kg)				
Mean \pm SD	20.33 \pm 6.4	22.17 \pm 6.6	t	
Range	11-34	10-37	0.69	0.49
Age per years				
Mean \pm SD	5.0 \pm 3.13	5.67 \pm 2.19	U	
Range	3-12	3-11	1.62	0.105
Maturity n (%)				
Full term	12(100.0)	12(100.0)	-	-

Data were expressed as number and percent, or Mean \pm SD [SD=standard deviation, range f= Fisher Exact test, U: Mann Whitney test, t: student t-test, $p > 0.05$ was considered no significant

Table 2: Characters of hernia in studied groups

Variables	Group A N=12 n (%)	Group B N=12 n (%)	P
laterality hernia			
unilateral	10(83.3)	9(75.0)	
bilateral	2(16.7)	3(25.0)	0.99
Hernia side			
right side	7 (58.3)	9(75.0)	
left side	7(58.3)	6(50.0)	0.59c
Types of hernia			
Inguinal	11(91.7)	12(100.0)	
Inguinoscrotal	1(8.3)	0(0.0)	0.99
Associated hydrocele	0(0.0)	0(0.0)	-
Ultrasound Defect size(mm)right side			
Mean \pm SD	7.57 \pm 1.39	7.33 \pm 1.66	
Range	6-10	5-9.8	0.765t
Ultrasound Defect size(mm)left side			
Mean \pm SD	7.21 \pm 2.038	6.92 \pm 1.28	
Range	4-9.5	5-8.5	0.764t

Data were expressed as number and percent, or Mean \pm SD [SD=standard deviation, range, f= Fisher Exact test, χ^2 Chi-square test, t: student T-test, $p > 0.05$ was considered no significant

Table 3: number of open ports and duration of operation in the studied procedure.

Variables	Group A N=12	Group B N=12	Test of sig	P
	N(%)	N(%)		
Number of ports	one 12(100.0)	three 12(100.0)	-	-
Need for additional trochar insertion.	0.0	0.0	-	-
Duration of unilateral operation(min) Mean ±SD (Range)	27.5±2.3 (25-30)	66 ±7.1 (60-80)	t 16.7	0.0001*
Duration of bilateral operation(min) Mean ±SD (Range)	35 ±7.1 (30-40)	81±11.5 (68-90)	t 4.9	0.016*
t	3.1	2.7		
p	0.01*	0.02*		

Data were expressed as number and percent, or Mean ± SD [SD=standard deviation, range t: student' test *p<0.05 was considered significant.

Table 4: Post-operative Pain VAS score and Length of hospital stay in studied groups

Variable	Group A N=12	Group B N=12	p
Pain VAS score Mean ±SD range	1±0.67 0-2	4.75±0.75 4-6	0.0001 u
Duration of hospital stay per hour Mean ±SD (Range)	14.08±2 (12-18)	27.1±5.62 (20-36)	0.0001*

U: Mann Whitney test, p<0.05, considered significant

Table 5: Complications in studied groups

Variables	Group A N=12		Group B N=12		P
	n.	%	n.	%	
Intraoperative complications					
Injury to spermatic vessels/vas deferens	0	0.0	0	0.0	-
Ovarian lesions	0	0.0	0	0.0	-
Bleeding	1	08.3	3	25.0	0.59
Early post-operative complications					
Edema	0	0.0	3	25.0	0.217
Post-operative hematoma	0	0.0	0	0.0	-
Infection	0	0.0	0	0.0	-
Late post-operative complications					
Recurrence	0	0.0	0	0.0	-
hydrocele	0	0.0	0	0.0	-
Testicular atrophy	0	0.0	0	0.0	-
Iatrogenic testicular ascent	0	0.0	0	0.0	-
Stitch sinus	0	0.0	0	0.0	-

Data were expressed as numbers and percent, f= Fisher Exact test; p>0.05 was considered insignificant.

Table 6: Cosmotic outcome of the studied procedure.

Variable	Group A N=12	Group B N=12	χ^2	P
Cosmetic outcome (%)				
Excellent	10(83.3)	4(33.3)	6.17	0.013*
Good	2(16.7)	8(66.7)		

Data were expressed as number and percent, χ^2 Chi-square test, * $P < 0.05$ was considered significant.

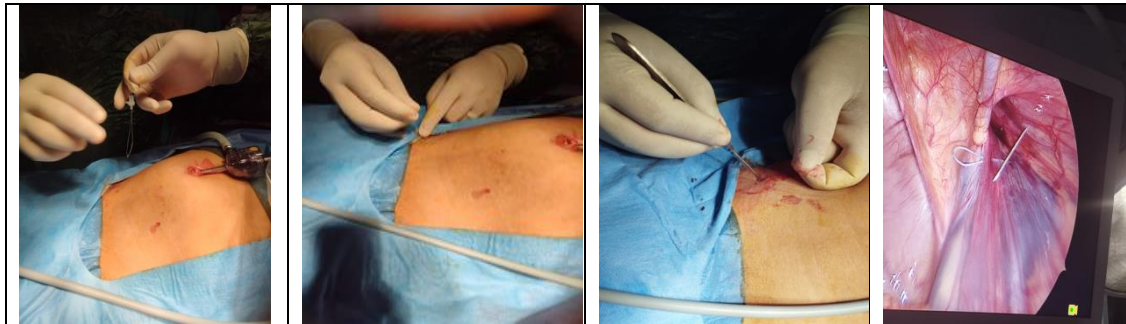


Figure 1: Percutaneous internal ring suturing (PIRS)

DISCUSSION

One of the most common pediatric surgeries is the treatment of an inguinal hernia. Surgery is necessary for all pediatric inguinal hernias in order to prevent the development of complications like incarceration or strangling[⁹].

Between 1 and 5% of infants and children are found to have an indirect inguinal hernia. The right side of the body is where 60% of hernias arise. Males are far more likely than females to suffer from inguinal hernias. An estimated 4:1 is the male-to-female ratio. It usually manifests as a noticeable protrusion at the ring's internal or exterior location or inside the scrotum[¹].

In our study, there was a male predominance in both groups, with 66.7 % in group A and 58.3 % in group B. The age of patients in group A ranged from 3 -to 12 years with a mean age of 5, and in group B, their ages ranged from 3 years to 11 years with a mean age of 5.67, respectively. In both groups, all the patients were full-term. This was consistent with many other studies done using laparoscopic-assisted percutaneous internal ring ligation, as Patkowski et al. [7] showed in a male-dominated research group. However, they studied 106 kids with 140 hernias, ranging in age from 28 days to 14.5 years.

At the time of presentation, 10 patients of group A presented with a unilateral hernia (83.3%), only two had a bilateral hernia (16.7%), seven patients had a hernia on the right side (58.3%), and the other seven had left side hernia (58.3%), with a mean defect on the right side 7.57 and 7.21 on the left side. Eleven patients had an

inguinal hernia (91.7%), and only one had an inguinoscrotal hernia. No one of the patients had associated hydrocele. In group B, nine patients presented with a unilateral hernia (75%), and only three had a bilateral hernia (25%); nine showed a hernia on the right side (75%), and the other six on the left side (50%), with a mean defect on the right side 7.33 and 6.92 on the left side. All hernias of this group were inguinal (100%).

In a study made by Madziba et al. [8] who operated on 94 patients, 15 had bilateral inguinal hernias; of these, 55 patients had unilateral hernias on the right side and 23 on the left.

In our study, the mean operative time of unilateral hernia in group A with PIRS was 27.5±2.3 minutes, and that of bilateral hernia was 35±7.1 minutes, which is nearly comparable with the results of Wolak et al. [9], who had a mean operating duration of 31 minutes for bilateral cases and 28 minutes for unilateral instances.

In Group B, the mean operative time for unilateral hernia was 66±7.1 mins, and for bilateral hernia, 81±11.5 mins. Other studies, such as Giseke et al. [10], observed faster times; depending on the technique's learning curve, they reported 26.2 minutes for unilateral hernias and 34.5 minutes for bilateral hernias using the typical laparoscopic approach.

The PIRS group has a significantly shorter operative time than the traditional laparoscopic group, which could be due to the long duration of dissection and suturing in the laparoscopic group.

A study by Shalaby et al. [11] revealed that every case was finished laparoscopically,

avoiding conversion, the need for a port, and any significant intraoperative complications.

Because PIRS reduces surgical stress and the inflammatory response, pain has diminished. Moreover, there is no evidence that PIRS alters or reduces testicular vascularization [12]. In our study, post-operative Pain VAS score ranged from 0-2 with a mean score of 1 ± 0.67 in (PIRS) procedure compared to a range of 4 to 6 with a mean score of 4.75 ± 0.75 in the traditional laparoscopic procedure. There was a significantly lower VAS pain score in (the PIRS) procedure compared to the traditional laparoscopic procedure.

According to Pogorelic et al.'s [13] investigation, none of their patients mentioned inguinal pain.

According to the postoperative follow-up data in our study, the mean duration of hospital stay in group A was 14.08 ± 2 hours, shorter than that of group B, which had a mean duration of 27.1 ± 5.62 hours. Baltrak et al. [14] found that the PIRS postoperative hospital stay was almost twice as long, 16.0 ± 8.2 hours.

In our study, there was no case reported with iatrogenic injury of the spermatic cord or vas deferens; also, no ovarian lesions were reported in either group. Only one case (8.3%) of bleeding was found in the PIRS group, compared to 3 (25%) cases in the traditional laparoscopic group, unlike Patkowski et al. [9] who reported three cases of iliac vein punctures that resulted in intraoperative bleeding and needed to be gently pressed from the outside for a brief period.

Regarding early postoperative complications, no case was reported with edema, hematoma, or infection in the PIRS group, while 3 cases (25%) had postoperative edema in the traditional laparoscopic group. This was due to extensive manipulation, which didn't happen in the PIRS group.

Pogorelic et al. [13] observed no complications, including testicular shrinkage, iatrogenic cryptorchidism, groin traction pain or discomfort, suture granuloma, or recurrence of the hernia.

Late post-operative complications such as recurrence, hydrocele, iatrogenic testicular ascent, and testicular atrophy were not reported in our study in neither group except for one case (8.3%) with stitch sinus in the PIRS group, and this is consistent with Shehata [14] stated that one patient (1.9%) had a stitch sinus, necessitating surgical intervention to clear the sinus, debride it, and bury the ends of the Prolene with Vicryl sutures.

Patkowski et al. [9] discovered that three hernia recurrences in boys were observed between two and four months after surgery. One boy was re-operated using PIRS. A retrospective report by Schier [15] of 884 patients found a recurrence rate of 3%.

Another study by Dutta and Albanese [16] showed that During a 2-year follow-up, four recurrences (1.5%) of 275 laparoscopic repairs were found. Smaller series with erratic follow-up have documented recurrence rates between 0% and 3% [17,18].

Patkowski et al. [9] stated that a tiny scar without any apparent thread narrowed the inguinal canal opening during the procedure. Five boys had transitory hydroceles that went away on their own in three to five months, but neither group in our study had any cases that developed into hydroceles.

Regarding cosmetic outcomes in the PIRS group, most cases had excellent outcomes, with no scars in the inguinal region and very minimal scars at the umbilicus that became invisible with time. In the traditional laparoscopic group, the cosmetic outcome was good, as a scar formed at the port site. This is consistent with Patkowski et al. [9] and Wolak et al. [9].

No wound complications or umbilical hernias developed. Five males (2.16%) developed hydrocele, which was entirely cured by conservative measurement after four weeks, with no evidence of testicular atrophy or iatrogenic ascent of the testis. During a mean follow-up time of 18.6 ± 1.2 months (range 11–36 months), no recurrence had been found, and the scars were almost unnoticeable in this study. Every parent conveyed their high level of happiness with the method and the invisible scars [11].

CONCLUSION

Compared to conventional laparoscopic inguinal herniotomy, laparoscopic-aided percutaneous internal ring ligation is thought to be a new, minimally invasive, safe, simple, and quick procedure that can be used for inguinal hernia repair in pediatrics.

The present study supports the recommendation of laparoscopic-assisted percutaneous internal ring ligation as a viable option for elective hernioplasty in the pediatric population.

We recommend considering our results as a potent updated idea regarding this issue. Thus, by paying attention to this fact while outlining the recent guidelines for the management of patients with inguinal hernia, we can help improve the

management of patients with pediatric inguinal hernia.

REFERENCES

- 1- Juang D, Fraser JD, Holcomb 3rdGW. The laparoscopic approach for repair of indirect inguinal hernias in infants and children. *Transl Pediatr.* 2016;5(4):222-226.
- 2- Gulack BC, Greenberg R, Clark RH, Miranda ML, Blakely ML, Rice HE. et al. A multi-institution analysis of predictors of timing of inguinal hernia repair among premature infants. *J Pediatr Surg.* 2018;53(4):784-788.
- 3- Morini F, Dreuning KMA, Janssen Lok MJH, Wester T, Derikx JP, Friedmacher F. Surgical Management of Pediatric Inguinal Hernia: A Systematic Review and Guideline from the European Pediatric Surgeons' Association Evidence and Guideline Committee. *Eur J Pediatr Surg.* 2022;32(3):219-232.
- 4- Olesen CS, Mortensen LQ, Öberg S, Rosenberg J. Risk of incarceration in children with an inguinal hernia: a systematic review. *Hernia.* 2019;23(2):245-254.
- 5- Thomas DT, Göcmen KB, Tulgar S, Boga I. Percutaneous internal ring suturing is a safe and effective method for the minimally invasive treatment of pediatric inguinal hernia: Experience with 250 cases. *J Pediatr Surg.* 2016;51(8):1330-1335.
- 6- Ravikumar VSR, Kumar HR, Gowda MRN. A clinical study on the management of inguinal hernias in children in the general surgical practice. *J Clin Diagn Res.* 2013;7(1):144-147.
- 7- Patkowski D, Czernik J, Chrzan R, Jaworski W, Apoznański W. Percutaneous internal ring suturing: a simple minimally invasive technique for inguinal hernia repair in children. *J Laparoendosc Adv Surg Tech A.* 2006;16(5):513-517.
- 8- Madziba S, Harilal S, Mangray H. Laparoscopic percutaneous internal ring suturing for pediatric inguinal hernias: a South African tertiary center experience. *S Afr J Surg.* 2021;59(4):149-152.
- 9- Wolak PK, Patkowski D. Laparoscopic inguinal hernia repair in children using the percutaneous internal ring suturing technique - own experience. *Wideochir Inne Tech Maloinwazyjne.* 2014;9(1):53-58.
- 10- Giseke S, Glass M, Tapadar P, Matthyssens L, Philippe P. A true laparoscopic herniotomy in children: evaluation of long-term outcome. *J Laparoendosc Adv Surg Tech A.* 2010;20(2):191-194.
- 11- Shalaby R, Negm M, El-Sawaf M, Elsaied A, Shehata S, Hamed A. et al. Telescopic Disconnection and Peritoneal Closure for Pediatric Inguinal Hernia Repair: A Novel Technique. *Surg Laparosc Endosc Percutan Tech.* 2021;32(2):272-278.
- 12- Jukić M, Pogorelić Z, Šupe-Domić D, Jerončić A. Comparison of inflammatory stress response between laparoscopic and open approach for pediatric inguinal hernia repair in children. *Surg Endosc.* 2019;33(10):3243-3250.
- 13- Pogorelić Z, Batinović T, Jukić M, Šušnjar T. Percutaneous Internal Ring Suturing is a Safe and Effective Method for Inguinal Hernia Repair in Young Adolescents. *J Laparoendosc Adv Surg Tech A.* 2022;32(4):452-457.
- 14- Shehata M. Laparoscopic assisted percutaneous internal ring suturing for inguinal hernia repair in pediatrics. *J of Ped Endosc Surg.* 2020; (2):145-152.
- 15- Schier F. The laparoscopic spectrum of inguinal hernias and their recurrences. *Pediatr Surg Int.* 2007;23(12):1209-1213.
- 16- Dutta S, Albanese C. Transcutaneous laparoscopic hernia repair in children: a prospective review of 275 hernia repairs with minimum 2-year follow-up. *Surg Endosc.* 2009;23(1):103-107.
- 17- Takehara H, Yakabe S, Kameoka K. Laparoscopic percutaneous extraperitoneal closure for inguinal hernia in children: clinical outcome of 972 repairs done in 3 pediatric surgical institutions. *J Pediatr Surg.* 2006;41(12):1999-2003.
- 18- Parelkar SV, Oak S, Gupta R, Sanghvi B, Shimoga PH, Kaltari D. et al. Laparoscopic inguinal hernia repair in the pediatric age group--experience with 437 children. *J Pediatr Surg.* 2010;45(4):789-792.

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